

This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

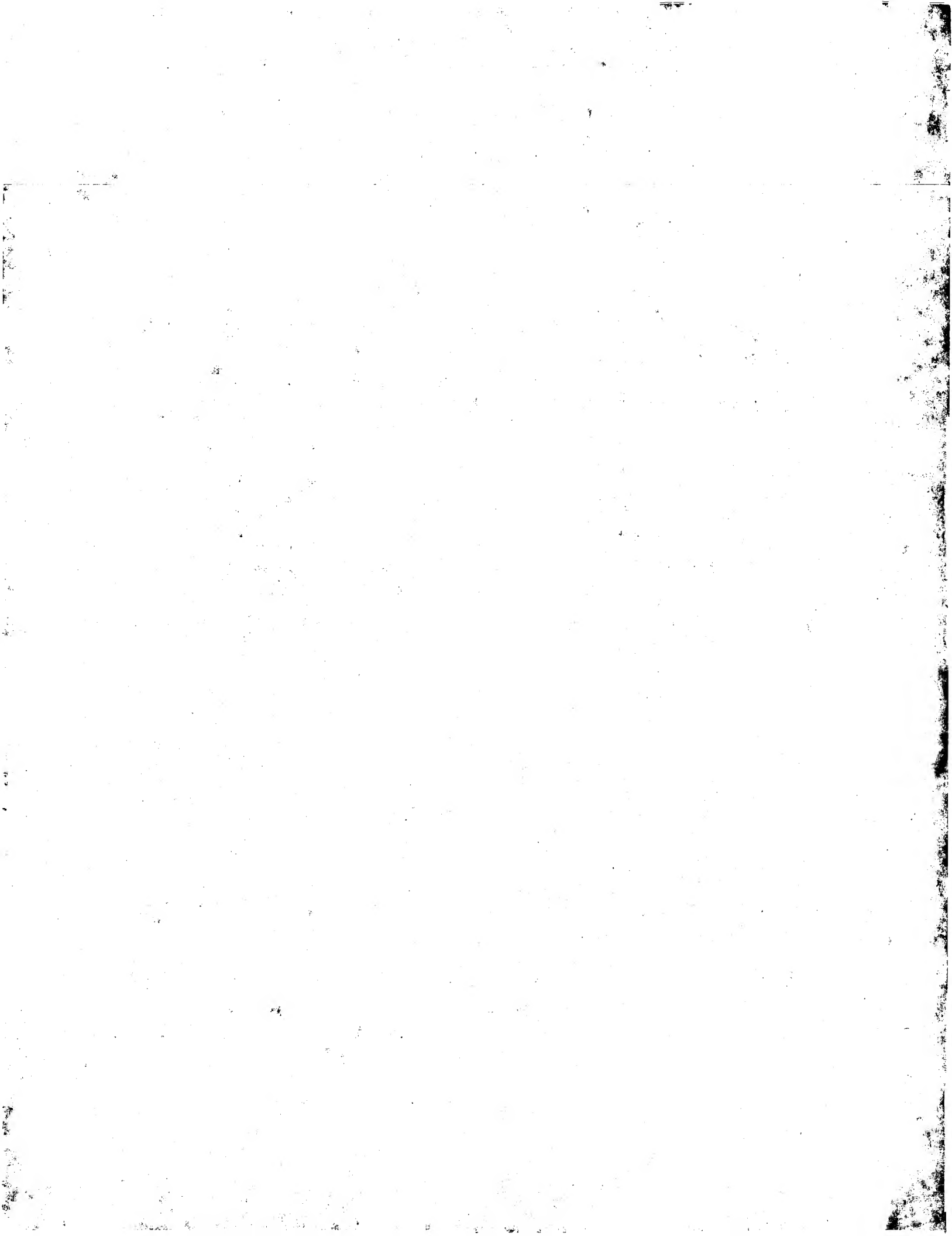
Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

**As rescanning documents *will not* correct images,
please do not report the images to the
Problem Image Mailbox.**

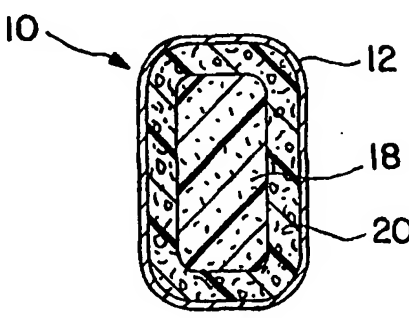


PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification⁶ : B62D 29/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 00/13958 (43) International Publication Date: 16 March 2000 (16.03.00)</p>
<p>(21) International Application Number: PCT/US99/18832 (22) International Filing Date: 2 September 1999 (02.09.99) (30) Priority Data: 09/149,978 9 September 1998 (09.09.98) US (71) Applicant: HENKEL CORPORATION [US/US]; Suite 200, 2500 Renaissance Boulevard, Gulph Mills, PA 19406 (US). (72) Inventor: WYCECH, Joseph, S.; 927 Lakeshore Road, Grosse Pointe Shores, MI 48236 (US). (74) Agent: HARPER, Stephen, D.; Henkel Corporation, Suite 200, 2500 Renaissance Boulevard, Gulph Mills, PA 19406 (US).</p>		<p>(81) Designated States: CA, IN, JP, KR, MX, TR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i></p>
<p>(54) Title: THREE DIMENSIONAL LAMINATE BEAM STRUCTURE</p> <div data-bbox="552 1155 958 1470"></div> <p>(57) Abstract</p> <p>A three-dimensional laminate beam (10) is formed by inserting a preformed foam core (18) insert within a hydra-formed metal section (12) having curved three-dimensional geometry. A reinforcing polymer (20) is pumped in and around the foam core insert so as to be adjacent the inside wall of the shell. The polymer bonds to the inside wall of the shell upon the polymer being cured.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

THREE DIMENSIONAL LAMINATE BEAM STRUCTURE

BACKGROUND OF THE INVENTION

For various applications, such as in the automotive
5 industry, it is desirable to reinforce a structural section.
One approach has been to use a polymer structural foam
material for such reinforcement. In some of these applica-
tions, however, because of the location or geometry of the
part being reinforced, it is difficult to accomplish the
10 intended reinforcement.

Hydra-formed metal sections, for example, may have
curved three-dimensional geometry. As a result, reinforcing
the section or component is very difficult because the
location of the hydra-formed section that is critical and
15 decides the overall performance of the component, is often
the section located at a major discontinuity "notch" or
curvature.

SUMMARY OF THE INVENTION

An object of this invention is to provide a reinforced
20 beam of curved geometry.

A further object of this invention is to provide
techniques for reinforcing such a beam.

In accordance with this invention the beam is a hollow
structure. A pre-molded foam core is inserted into the
25 hollow structure spaced from at least one inside wall of the
hollow structure. A polymer is pumped in and around the foam

core insert so that after curing the polymer bonds to the inside wall of the structure.

In a preferred practice of the invention the structure is a hydra-formed metal section, such as a vehicle control arm assembly. The pre-shaped foam insert is preferably made of a lightweight material to minimize the weight of the final laminate beam formed by the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a laminated control arm assembly beam in accordance with this invention; and

Figure 2 is a cross-sectional view taken through Figure 1 along the line 2-2.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is particularly useful for reinforcing hollow sections or structures, which are of curved geometry and/or located at locations, which are relatively inaccessible.

In the preferred practice of the invention the hollow structure is a metal section, such as a hydra-formed metal section with curved three-dimensional geometry. An example of such section is a control arm assembly, wherein it is desired to reinforce the control arm beam. For such hydra-formed section the critical portion which requires reinforcement in order to maximize the overall performance of the component is often the portion at a major section discontinuity "notch" or curvature. Figure 1, for example,

illustrates an automotive control arm assembly beam 10 made of a hydra-formed metal shell 12 of conventional size and shape and structure such as including through holes 14 and end walls 16. As can be seen the shell 12 has a three dimensional geometry which is non-uniform from end wall to end wall and which is curved.

Because of its geometry, it is very difficult to reinforce a control arm beam 10 by conventional practices.

In accordance with this invention a preformed foam core 18 is inserted into the hollow or cavity of shell 12. Core 18 is spaced away from at least one inside wall of the hollow shell 12 and is shaped to extend along at least one side of the shell. Core 18 functions to locate a reinforcing polymer 20 within the hollow shell so that after curing the polymer will bond to and reinforce the inside wall of the shell.

Core or insert 18 is made of a lightweight pre-shaped or preformed material such as urethane, phenolic or expanded polystyrene. The polymer 20 would be pumped in and around the foam core 18 so as to be located in the space between core insert 18 and the inner wall of shell 12. Polymer 20 is then cured such as being heat cured or ambient temperature cured. Upon curing polymer 20 is bonded to the inner wall of shell 12 and to foam core 18 to function as a structural foam. The polymer or structural foam may be, but is not necessarily an expandable foam.

Examples of suitable foam material are found in my U.S. Patent No. 5,575,526 and in co-pending application Serial No.

09/103,031 filed June 23, 1998, all of the details of that patent and application are incorporated herein by reference thereto.

The curing of the polymer could be accomplished in any
5 suitable manner. For example, where the shell 12 is a vehicle component, the polymer could be heat cured in an oven such as an e-coat oven during the manufacturing of the vehicle. Alternatively, the polymer could be cured at ambient temperatures such as, for example, about 77°F.

10 The foam core insert 18 may be pre-shaped in a geometry which generally conforms to the inner surface of shell 12 thereby minimizing the amount of polymer material required to fill the remaining open space within shell 12. Alternatively, core insert 18 may be of uniform cross-
15 sectional shape throughout all or most of its length to simplify the structure of the core insert, but which would result in a greater amount of open space. The foam core insert 18 thus comprises a three-dimensional or essentially two dimensional molded pre-formed part which occupies some
20 of the volume or space within shell 12 and provides a substrate for the polymer 20 which is pumped into the shell 12.

The invention thus results in a three-dimensional laminate beam, which is formed by pumping the polymer around
25 the pre-molded foam core. This is the only means necessary to reinforce such a hydra-formed metal section.

IN THE CLAIMS:

1. A three dimensional laminate beam structure comprising
an outer shell having inside walls and an open space
between said walls, at least a portion of said shell
5 being curved, a core insert mounted within said shell
spaced from at least one of said inside walls, a
reinforcing polymer within said shell, and said polymer
being disposed against said core insert and bonded to
said inside wall of said shell.
- 10 2. The beam of claim 1 wherein said core insert is made of
a lightweight foam.
3. The beam of claim 2 wherein said polymer is pumped in
and around said foam core insert.
4. The beam of claim 3 wherein said shell is made of a
15 metal material being of non-uniform shape along its
length.
5. The beam of claim 4 wherein said shell is a hydra-formed
metal section.
6. The beam of claim 5 wherein said beam comprises a
20 vehicle control arm assembly.
7. The beam of claim 3 wherein said polymer is an
expandable structural foam.
8. The beam of claim 3 wherein said polymer is a non-
expandable structural foam.
- 25 9. The beam of claim 3 wherein said polymer is heat
curable.

10. The beam of claim 3 wherein said polymer is ambient temperature curable.
11. A method of forming a three-dimensional laminate beam comprising the steps of inserting a pre-formed core insert within a hollow shell with the insert spaced from at least one inside wall of the shell and with the shell being of curved shape, pumping a reinforcing polymer in and around the core insert, and curing the polymer to cause the polymer to bond to the inside wall of the shell.
12. The method of claim 11 including pre-molding the core insert from a lightweight foam material.
13. The method of claim 12 wherein the shell is made of a hydra-formed metal section of non-uniform shape along its length.
14. The method of claim 12 wherein the resulting beam is a vehicle control arm assembly.
15. The method of claim 13 wherein the resulting beam is a vehicle component.
16. The method of claim 15 wherein the polymer is heat cured.
17. The method of claim 15 wherein the polymer expands upon curing.
18. The method of claim 15 wherein the polymer is cured at ambient temperatures.

1/1

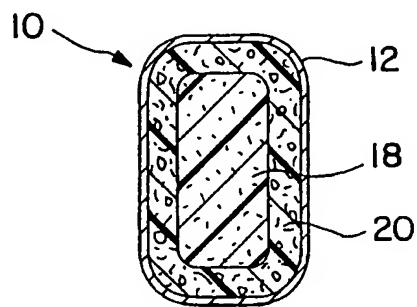
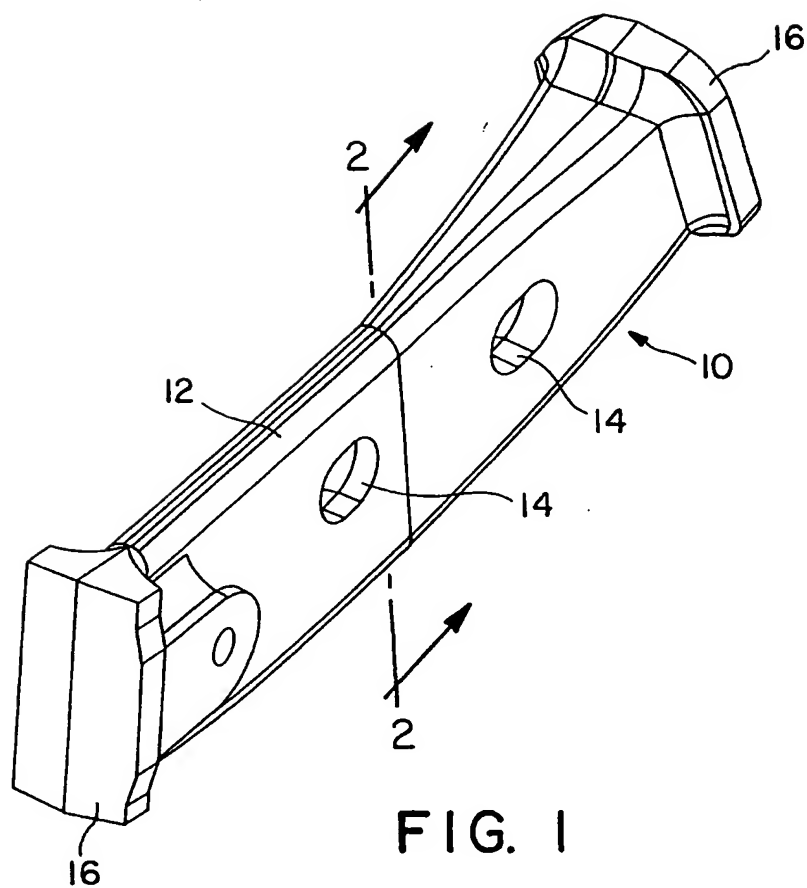


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18832

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) :B62D 29/00 US CL :Please See Extra Sheet. According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : Please See Extra Sheet. Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched NONE Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) NONE		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	US 5,806,919 A (DAVIES) 15 SEPTEMBER 1998 (15/09/98), SEE ENTIRE DOCUMENT, ESPECIALLY FIGURES 1-2.	1-10
X,P	US 5,866,052 A (MURAMATSU) 02 FEBRUARY 1999 (02/02/99), SEE ENTIRE DOCUMENT, ESPECIALLY FIGURE 6(C).	1-10
X	US 4,722,563 A (LOREN ET AL.) 02 FEBRUARY 1988 (02/02/88), SEE ENTIRE DOCUMENT, ESPECIALLY FIGURE 11.	1-3, 7-12, 14-18
X	US 5,575,526 A (WYCECH) 19 NOVEMBER 1996 (19/11/96), SEE ENTIRE DOCUMENT, ESPECIALLY FIGURE 11.	1, 11, 13
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents: *A* document defining the general state of the art which is not considered to be of particular relevance *B* earlier document published on or after the international filing date *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) *O* document referring to an oral disclosure, use, exhibition or other means *P* document published prior to the international filing date but later than the priority date claimed	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art *A* document member of the same patent family	
Date of the actual completion of the international search 13 OCTOBER 1999		Date of mailing of the international search report 09 DEC 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer <i>Debra Gordon</i> LAURA A. CALLO Telephone No. (703) 308-2168

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/18832

A. CLASSIFICATION OF SUBJECT MATTER:

US CL :

29/897.2; 52/735.1, 731.6; 264/46.4, 46.5, 46.6; 296/187, 205, 901

B. FIELDS SEARCHED

Minimum documentation searched

Classification System: U.S.

29/897.1, 897.2, 897.35; 52/731.6, 735.1, 737.4, 738.1, 309.3, 309.4

309.5, 309.6, 309.7, 309.9, 309.14, 309.15, 309.16, 739.1; 264/46.4, 46.5, 46.6; 293/109, 120; 296/187, 205, 900, 901

